

C-4.3 Analyze the energy changes (endothermic or exothermic) associated with chemical reactions.

Revised Taxonomy Level 4 Analyze conceptual knowledge

In physicals science, students

- ❖ Summarize characteristics of balanced chemical equations (including conservation of mass and changes in energy in the form of heat –that is, exothermic or endothermic reactions). (PS-4.7)

It is essential for students to

- ❖ Show energy changes in chemical reactions (for example)
 - Endothermic reaction
 $2\text{H}_2\text{O} + \text{energy} \rightarrow 2\text{H}_2 + \text{O}_2$
 - Exothermic reaction
 $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{energy}$
- ❖ Understand that the “heat of reaction” is the quantity of energy released or absorbed as heat during a chemical reaction.
Teacher note: “heat of reaction” should be expressed in terms of kJ per mole, so quantitative application of this concept should not be introduced until after students have mastered the mole concept.
- ❖ Understand enthalpy as the energy absorbed or released as heat during a chemical reaction at constant pressure
 - Explain the relationship between enthalpy change and the tendency of a reaction to occur.
- ❖ Understand that some endothermic reactions may be spontaneous due to an increase in entropy, a measure of the degree of randomness of the particles, such as molecules, in a system.
 - Explain the relationship between entropy change and the tendency of a reaction to occur.
 - Explain the relationship between various conditions and the entropy of the system
 - Temperature
 - Phase
 - Formation of solutions

Assessment

The revised taxonomy verb for this indicator is analyze, which means to “break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose”. In this case, students should be able to predict the spontaneity of a chemical reaction based on the heat of reaction and the enthalpy change. Because the indicator is written as conceptual knowledge, assessments should require that students understand the “interrelationships among the basic elements within a larger structure that enable them to function together.” In this case, assessments must show that students understand the conditions that influence both enthalpy and entropy and that both factors play a role on determining the spontaneity of a chemical reaction.